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CEREAL EXPERIMENTS ON THE CHEYENNE EXPERIMENT FARM, ARCHER, WYO.

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[In cooperation with the Wyoming State Board of Farm Commissioners.]

CONTENTS.

INTRODUCTION.

The cooperative experiments conducted on the Cheyenne Experiment Farm, Archer, Wyo., were started in 1912.[1] Three years' results of the work are now available. It is realized that three years in a dry-farming district is too short a period to warrant the drawing of conclusions. However, the demand for available facts is very strong and these data should be interesting and helpful to those engaged in dry farming in the higher parts of the northern Plains area. Therefore, it seems advisable at this time to present the results thus far obtained.

Cooperation between the Bureau of Plant Industry and the Wyoming Board of Farm Commissioners was effected on July 1, 1912. According to the memorandum of understanding between the two parties—

> The objects of these cooperative investigations shall be (*a*) to improve the cereals of the northern Plains area by introducing or breeding better varieties than those now grown, with special reference to earliness, drought resistance, winter hardiness, quality, yield, etc.; and (*b*) to determine the best methods of cereal production under dry-land conditions in the area named.

[1] The writer was superintendent of the Cheyenne Experiment Farm from September 1, 1912, until April 30, 1915, when he returned to the Nephi substation, in Utah. Mr. Victor H. Florell was appointed scientific assistant in cereal investigations and superintendent of the experiment farm on April 20, 1915, and was in charge during the cropping season of 1915. Credit is hereby given him for the results obtained in that year.

The results obtained at Archer are applicable to a greater or less extent to northeastern Colorado, western Nebraska, a narrow portion of western South Dakota, and to eastern Wyoming. However, the climatic conditions in any particular locality should be compared carefully with those obtaining at Archer before the data are too widely applied. The elevation at Archer is as great and the climatic conditions probably are as severe as in the other districts mentioned, so that the results should be quite generally applicable.

This bulletin contains (1) a description of the district to which the results apply, (2) a description of the Cheyenne Experiment Farm and the scope and method of the experiments conducted there, and (3) the results of these experiments with different field crops and cropping methods.

DESCRIPTION OF THE DISTRICT.

The district here described includes the plains of southeastern Wyoming, western Nebraska, and northeastern Colorado. The results presented in this bulletin are believed to be generally applicable to this district.

HISTORY.

The district was first used for stock grazing. It was the home of ranchmen who owned or leased large areas of land. The ranches were located on streams or springs, in order to have water available for stock during the summer months.

When Wyoming was admitted as a State in 1890, 4,042,160 acres were granted by Congress for educational and other public purposes. By a provision in a law approved in 1891 no State lands could be sold at less than $10 per acre. As a result of this law, up to 1902 only a little over 5,000 acres of State land had been sold. Meantime numerous provisions had been enacted for leasing the State lands in order to secure some revenue from them. Leasing prices ranged from 2½ to 25 cents per acre annually, the price depending on whether the land was accessible to water for stock or for irrigation. The land leased readily and ranchmen became prosperous. The high sale price of State lands and the large area leased, including practically all the natural watering places, have operated to keep out the small dry-land farmer. The opposition of the ranchmen to general farming is another factor that has retarded cereal production in Wyoming.

As the population increased and land prices became higher in the Central States large numbers of people have continued to move westward. This western migration, which has been especially marked during the past decade, has resulted in the settlement or homesteading of large areas of the higher Plains region, formerly used for grazing.

The new settlers on these lands for the most part come from the Central States. They come into an area that requires farming methods different from those to which they are accustomed. They are confronted by numerous and varied problems of crop adaptation and production which are entirely new to them. Reliable information on crops and farm practices is seriously needed.

TOPOGRAPHY.

The district outlined above lies to the east of the foothills of the Rocky Mountains, at an elevation ranging from 5,000 to 6,000 feet. The land is gently rolling. It slopes eastward from the foothills to about 102° W. longitude, which may be called the eastern boundary of the higher western Plains area. In this district the summers are short and only short-season crops will mature.

SOILS.

The soils of the district are of varying types, ranging from light sandy loam to a very heavy impervious clay loam. They are underlain with gravel at some points and with hardpan at others. The humus content of the soil generally is low over the entire district. The soil in many localities is very light and subject to drifting, while in other localities it is very heavy and difficult to work. In general, however, the soil is fairly easy to work and is rich in plant food elements. While it is low in humus content, crop yields are usually good when the moisture supply is not too limited.

VEGETATION.

The native grass vegetation of southeastern Wyoming consists largely of buffalo grass (*Bulbilis dactyloides*), blue grama (*Bouteloua oligostachya*), western wheat-grass (*Agropyron smithii*, formerly *A. occidentale*), and little bluestem (*Andropogon scoparius*). These are common grasses of much of the Great Plains area. They are drought resistant, nutritious, and well suited for grazing purposes.

The most abundant native legumes are *Thermopsis divaricarpa*, milk vetch (*Astragalus adsurgens* and *A. bisulcatus*), narrow-leaved vetch (*Vicia linearis*), and lupine (*Lupinus pusillus*). Some vetches and lupines when green are considered poisonous to animals, but are not believed to be poisonous when cured.

Russian thistle (*Salsola tragus*), Canada thistle (*Carduus arvensis*), yellow mustard (*Brassica* and *Sisymbrium* spp.), and tumbleweeds (*Amaranthus* spp.) are among the most common weeds, particularly on land where the native sod has been broken.

CLIMATE.

There are at least three distinct climatic factors that influence directly or indirectly the yields of crops in semiarid regions. These are (1) precipitation, particularly the distribution of the rainfall; (2)

wind, particularly that which passes directly over the ground during the crop season; and (3) temperature, with special reference to the length of the frost-free period in a given locality.

PRECIPITATION.

Rainfall is undoubtedly the most important factor in crop production in southeastern Wyoming. Table I shows the monthly, seasonal (April to July), and annual precipitation at Cheyenne, Wyo., in the 16-year period, 1900 to 1915, inclusive. The seasonal and annual precipitation are shown graphically in figure 1.

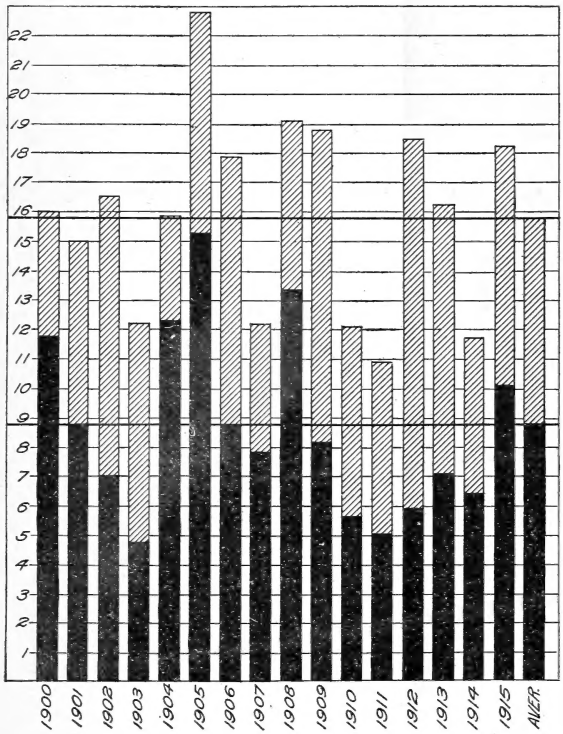

FIG. 1.—Diagram showing the seasonal and the annual precipitation (in inches) at Cheyenne, Wyo., for 16 years, 1900 to 1915, inclusive.

Table I shows that the highest monthly precipitation during the 16-year period was 7.66 inches, in April, 1900. The lowest monthly precipitation during that period was a trace, in November, 1901. The highest seasonal (April to July) precipitation recorded during the 16 years was 15.36 inches, in 1905. The lowest seasonal precipitation was 4.77 inches, recorded in 1903. The average seasonal precipitation was 8.59 inches.

The highest annual precipitation recorded during the 16-year period was 22.68 inches, in 1905. The lowest annual precipitation during the same period was 10.85 inches, in 1911. The average annual precipitation for the 16 years was 15.78 inches.

The monthly precipitation varies widely from year to year. Marked variations are observed also in the seasonal and annual precipitation of the different years.

The growing season, or the period during which spring cereals make most of their growth, covers the four months from April to July, inclusive. It is the rainfall during these four months that is of most vital concern in crop growth. Most crop failures other than those caused by factors of limited duration, such as hot wind, frost, or hail, are due to the insufficiency or poor distribution of the moisture during these months. According to the data recorded in Table I for the 16 years, 1900 to 1915, about 54 per cent of the annual precipitation comes between April 1 and July 31, the period of most active crop growth.

TABLE I.—*Monthly, seasonal (April to July), and annual precipitation at Cheyenne, Wyo., for the 16-year period, 1900 to 1915, inclusive.*

[Data (in inches) from the records of the United States Weather Bureau except as noted.]

Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Seasonal.	Annual.
1900	0.15	1.25	0.72	7.66	0.76	1.01	1.20	0.70	2.19	0.03	0.09	0.33	10.63	16.09
1901	.13	1.10	1.54	2.97	2.47	1.93	1.34	.83	.75	.31	[a]T	1.62	8.71	14.99
1902	.21	.55	2.11	1.49	2.51	1.55	1.49	.53	3.52	.52	.23	1.79	7.04	16.50
1903	.20	1.76	1.00	2.10	.46	1.42	.79	1.90	1.40	.34	.79	.09	4.77	12.25
1904	.35	.33	.45	1.80	6.66	1.78	2.00	.87	.83	.57	.02	.06	12.24	15.72
1905	.84	.69	1.27	6.45	4.04	1.90	2.97	1.93	1.06	1.40	.11	.02	15.36	22.68
1906	.21	.21	2.27	3.10	1.30	2.42	1.89	.49	1.86	2.33	1.42	.15	8.73	17.65
1907	.42	.49	.49	1.32	2.78	.34	3.50	.80	92	.08	.59	.55	7.94	12.34
1908	.36	.20	.16	.36	6.19	2.52	4.33	2.45	.09	1.14	.59	.70	13.40	19.09
1909	.33	1.42	3.22	.97	2.15	4.01	1.08	1.40	1.37	.28	.73	.66	8.21	17.62
1910	.29	.31	1.45	1.14	2.34	.76	1.32	.62	1.80	1.04	.29	.69	5.56	12.05
1911	.49	.56	.16	1.93	.33	1.64	1.21	1.35	1.35	.95	.59	.29	5.11	10.85
1912	.44	1.60	1.33	1.62	1.37	1.17	1.82	1.44	3.91	2.59	.58	.63	5.98	18.50
1913	.55	.74	.33	1.35	2.22	[b]1.51	[b]2.06	[b]2.09	[b]2.23	1.43	.37	2.00	7.14	16.28
1914	.10	.23	.72	[b]2.54	[b]1.46	[b]1.12	[b]1.43	[b]2.03	[b].32	1.29	.26	.16	6.55	11.66
1915	.08	.49	.71	[b]4.90	[b]1.78	[b]1.83	[b]1.65	[b]2.53	[b]1.95	[b]1.81	[b].03	[b].56	10.16	18.32
Average	.32	.75	1.12	2.61	2.43	1.68	1.88	1.37	1.60	1.01	.42	.64	8.59	15.78
Maximum	.84	1.76	3.22	7.66	6.66	4.01	4.33	2.53	3.91	2.59	1.42	2.00	15.36	22.68
Minimum	.08	.20	.16	.36	.33	.34	.79	.49	.09	.03	T	.02	4.77	10.85

[a] T=trace.
[b] Data obtained at the Cheyenne Experiment Farm by the Office of Biophysical Investigations of the Bureau of Plant Industry.

EVAPORATION.

Second to precipitation in importance is evaporation, especially that which occurs during the growing season. Table II shows the monthly evaporation and precipitation at Archer for the four months of this season in each of the three years 1913, 1914, and 1915. The evaporation here recorded is from a free water surface. June and July are the months of highest evaporation at Archer. The total evaporation for the four months varies considerably, ranging from 20 inches in 1915 to 25.58 inches in 1914.

The ratio of precipitation to evaporation during the growing season in 1913 to 1915, inclusive, is interesting and instructive. The data show that the ratio varies widely in the different years. The higher the precipitation, the nearer the ratio approaches equality and the higher the crop yields. Low evaporation is associated with high yields, provided the rainfall is normal. The evaporation during

April is naturally much lower than that during the warmer months. In the only year in which a good crop was obtained, the precipitation was high and the evaporation low, making a ratio of 1:2.

TABLE II.—*Monthly and total precipitation and evaporation from a free water surface at the Cheyenne Experiment Farm, Archer, Wyo., in the months of April to July, inclusive, for 1913, 1914, and 1915.*

[Data (in inches) obtained by the Office of Biophysical Investigations of the Bureau of Plant Industry, except as noted.]

Year.	April.		May.		June.		July.		Total.		Ratio, precipitation to evaporation.
	Precipitation.	Evaporation.	Precipitation.	Evaporation.	Precipitation.	Evaporation.	Precipitation.	Evaporation.	Precipitation.	Evaporation.	
1913	[a]1.35	[b]3.217	[a]2.22	[b]5.304	1.51	7.104	2.06	7.756	7.14	23.381	1:3.27
1914	2.54	3.574	1.46	5.703	1.12	8.317	1.43	7.987	6.55	25.581	1:3.91
1915	4.90	3.160	1.78	4.701	1.83	5.557	1.65	6.638	10.16	20.056	1:1.97

[a] Data from United States Weather Bureau at Cheyenne, Wyo. [b] Interpolated.

WIND.

Wind velocities have been recorded at Cheyenne during a long series of years. The average wind velocity in miles per hour, by months, from April to July of each year, in the 16-year period from 1900 to 1915, inclusive, is given in Table III. Strong winds are quite common in southeastern Wyoming, and crops are damaged at times by the drifting soil. The highest velocities are recorded during the late fall and winter months. April has the highest average hourly velocity for the months under discussion, 11.2 miles, and July the lowest, 8.5 miles, per hour. The anemometer was located at a height of 64 feet above the ground. These readings, therefore, probably are higher than they would have been if the anemometer had been located just above the surface. Evaporation usually increases with wind velocity. In the winter months the snowfall is, as a rule, blown to the lower levels, leaving the winter crops exposed. For this reason winter-killing of fall-sown crops is common.

TABLE III.—*Average wind velocity at Cheyenne, Wyo., by months, from April to July of each year, during the 16-year period, from 1900 to 1915, inclusive.*

[Data (in miles per hour) from the records of the United States Weather Bureau.]

Year.	April.	May.	June.	July.	Average.	Year.	April.	May.	June.	July.	Average.
1900	9.3	9.5	9.5	8.5	9.2	1909	11.6	12.5	8.2	8.2	10.1
1901	10.1	9.9	9.4	8.2	9.4	1910	11.8	10.1	10.1	8.1	10.0
1902	10.2	10.1	10.6	8.6	9.9	1911	11.6	11.6	8.9	8.9	10.3
1903	11.6	11.0	8.4	9.9	10.2	1912	11.6	11.9	9.1	8.3	10.2
1904	12.0	10.5	8.9	8.5	10.0	1913	10.1	8.6	10.2	8.5	9.4
1905	9.9	10.0	10.2	7.9	12.0	1914	13.5	11.1	12.1	9.7	11.6
1906	10.8	10.3	11.9	7.1	10.0	1915	11.8	12.1	12.1	10.8	11.7
1907	11.6	10.0	9.8	7.9	9.8						
1908	11.9	11.5	9.3	7.3	10.0	Average	11.2	10.7	9.9	8.5	9.8

TEMPERATURE.

The maximum, minimum, and mean temperatures for the four months, April to July, of each year during the 16-year period from 1900 to 1915, inclusive, are shown in Table IV. The highest temperature recorded during the entire period was 95° F. and the lowest 4° F. The summers are not extremely hot and the nights are always cool.

TABLE IV.—*Maximum, minimum, and mean temperatures at Cheyenne, Wyo., by months, from April to July of each year, for the 16-year period, 1900 to 1915, inclusive.*

[Data (in ° F.) from the records of the United States Weather Bureau.]

Year.	April.			May.			June.			July.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
1900	69	6	40.2	81	25	54.8	92	40	65.4	90	39	64.9
1901	79	8	40.2	77	31	53.7	90	35	60.0	95	44	71.4
1902	74	9	41.6	82	28	52.8	92	37	61.0	93	40	63.8
1903	71	4	40.0	77	24	48.0	88	30	56.9	89	40	66.8
1904	72	15	41.5	77	26	49.2	80	36	57.2	87	37	63.2
1905	73	12	37.3	77	25	47.2	88	42	61.6	88	42	63.8
1906	74	16	43.2	77	27	51.0	88	33	57.9	88	39	62.9
1907	72	15	39.3	80	8	45.4	83	36	58.1	91	43	66.3
1908	75	7	44.2	81	23	47.8	85	40	57.9	89	36	65.0
1909	70	10	36.0	75	18	46.8	89	41	61.3	93	44	68.0
1910	82	21	46.4	79	25	49.6	91	37	62.7	95	43	69.2
1911	71	14	41.4	79	25	52.2	87	43	64.6	86	42	64.7
1912	62	17	40.2	81	28	50.4	86	33	58.5	86	46	65.0
1913	73	19	43.1	81	28	52.0	88	40	60.8	92	43	65.2
1914	67	12	40.2	76	27	51.1	85	41	61.4	86	43	66.6
1915	70	26	46.0	79	21	46.4	78	29	54.6	89	33	62.3
Average	72	13	41.3	79	24	49.9	87	37	59.9	90	41	65.6

Data showing the dates of the latest frost in spring and the first frost in autumn and the length of the frost-free period for each year from 1900 to 1916 are presented in Table V. These data were obtained from the records of the United States Weather Bureau at Cheyenne, Wyo.

TABLE V.—*Dates of killing frosts, the last in spring and the first in autumn, with the length of the frost-free period, at Cheyenne, Wyo., in each year, 1900 to 1915, inclusive.*

[Data obtained from the records of the United States Weather Bureau.]

Year.	Dates of killing frosts.		Frost-free period.	Year.	Dates of killing frosts.		Frost-free period.
	Last in spring.	First in autumn.			Last in spring.	First in autumn.	
			Days.				*Days.*
1900	May 19	Sept. 26	129	1909	May 25	Sept. 22	119
1901	May 22	Sept. 16	117	1910	May 22	Aug. 25	94
1902	May 21	Sept. 12	113	1911	May 27	Oct. 19	144
1903	June 1	Sept. 14	105	1912	May 14	Sept. 15	123
1904	May 17	...do....	119	1913	May 3	Sept. 20	139
1905	May 16	Oct. 9	145	1914	May 7	Sept. 14	130
1906	May 6	Oct. 4	150	1915	June 13	Oct. 5	114
1907	May 14	Sept. 20	128				
1908	May 10	Sept. 26	138	Average	May 18	Sept. 21	125

The United States Weather Bureau, in reporting killing frosts, uses the staple crops of any given locality as a basis for determining the character of a given frost. Therefore, a temperature of 32° F. is not necessarily a killing frost, depending on the hardiness of the staple crops grown in the area under discussion.

At Cheyenne the average frost-free period is 125 days.

CHEYENNE EXPERIMENT FARM.

LOCATION.

The Cheyenne Experiment Farm is located in Laramie County, in southeastern Wyoming, about 8 miles east of Cheyenne and half a mile southeast of Archer. Archer is on the Union Pacific Railroad, while Cheyenne is on the Union Pacific, the Colorado & Southern, and the Chicago, Burlington & Quincy Railroads. The farm is about

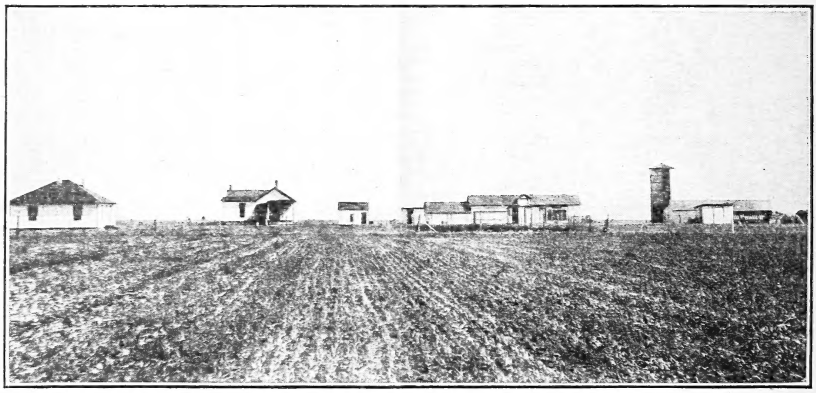

FIG. 2.—Buildings on the Cheyenne Experiment Farm, Archer, Wyo., in 1915. (Photograph lent by the Office of Dry-Land Agriculture Investigations.)

35 miles west of the Nebraska State line and 15 miles north of the Colorado State line. It lies in about 41° 8′ N. latitude and 104° 48′ W. longitude. A view of the farm buildings is shown in figure 2, of the barns and silo in figure 3, and of a farmers' round-up at the station in figure 4.

DESCRIPTION.

The farm consists of 250 acres. It was part of a large cattle ranch and for years had been used for grazing purposes. The soil is a sandy loam, varying in depth from 3 to 6 feet. Below these depths the soil is gravelly or sandy. The surface soil contains a low percentage of humus.

The farm slopes gently a little south of east and excellent surface drainage is afforded.

A map of the farm is shown in figure 5. The experimental work has been conducted on the west field. This field, of about 100

acres, is laid out in series lettered from A to L, inclusive. Each contains 67 tenth-acre plats except series J, K, and L, each of which contains only 46 tenth-acre plats. Eighteen acres of this field are devoted to rotation experiments under the direction of the Office of Dry-Land Agriculture Investigations. The soil on the entire experimental area is as uniform as can be expected in this district and is fairly representative of the soil of southeastern Wyoming.

SCOPE OF THE EXPERIMENTS.

Varietal experiments in plats have been conducted with winter and spring wheat, emmer, and oats, and with spring barley, flax, and proso. Rate-of-seeding and date-of-seeding tests have been made with winter wheat and with spring wheat, oats, barley, and flax.

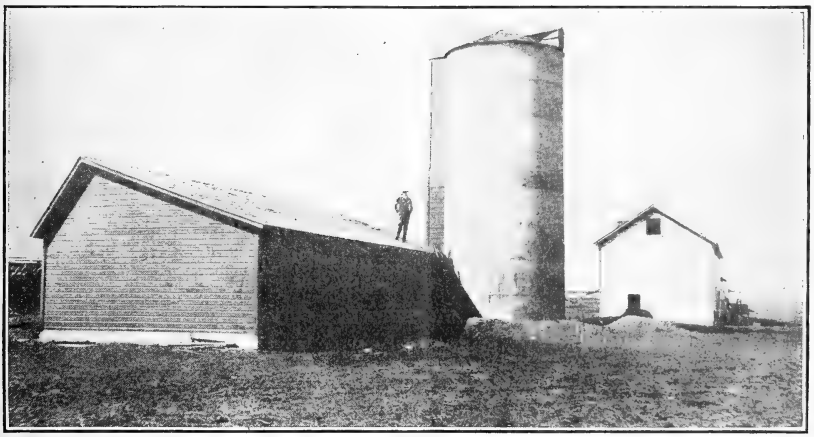

FIG. 3.—Silo and cow barn on the Cheyenne Experiment Farm, Archer, Wyo. (Photograph lent by the Office of Dry-Land Agriculture Investigations.)

In 1913, 7 varieties of winter wheat, 1 of winter emmer, 32 varieties and 11 pure lines of spring wheat, 14 varieties of oats, 16 of barley, 12 of flax, 8 of proso, and 8 of grain sorghum were grown at Archer. Rate-of-seeding and date-of-seeding tests with 2 winter wheats, 1 spring wheat, 1 spring oats, and 1 spring barley and a date-of-seeding test with flax were also conducted. In 1914 the number of winter wheats was materially increased. A few flax varieties and a rate-of-seeding test with flax also were added. In 1915 the number of varieties and experiments was about the same as in 1914.

EXPERIMENTAL METHODS.

Two general methods of experimentation have been used at Archer. Cereal varieties have been tested in field plats and in nursery rows. It is possible to test economically a much larger

number of varieties in the nursery than in the plats. Only the data obtained from the plat tests are reported in this paper. All rate-of-seeding and date-of-seeding experiments have been conducted on field plats.

SIZE AND ARRANGEMENT OF PLATS.

In 1913 and 1914 tenth-acre plats were used in varietal, rate-of-seeding, and date-of-seeding experiments. The plats were 2 by 8 rods, or 33 by 132 feet, arranged in series of 67 plats. The plats in each series were separated by 5-foot alleys and the series of plats were separated by 20-foot roadways. Thus each plat was bordered on each side by a 5-foot alley and on each end by a 20-foot road. In 1915 the plats used were a thirtieth and a twentieth of an acre, being 11 by 132 feet and 16.5 by 132 feet, respectively. The thir-

FIG. 4.—Farmers' round-up on the Cheyenne Experiment Farm, Archer, Wyo. Each year the farmers in the community visit the station and inspect the experimental work. (Photograph lent by the Office of Dry-Land Agriculture Investigations.)

tieth-acre plats were separated by 18-inch alleys and the twentieth-acre plats by 30-inch alleys. Thus the thirtieth-acre plats were bordered on the sides by 18-inch alleys and on the ends by 20-foot roads. The twentieth-acre plats had 30-inch alleys on each side and 20-foot roads on each end. The long dimension of the series extended east and west, while that of the plats extended north and south. The series are designated by the letters A to M. The plats are numbered from 1 to 67, inclusive.

REPLICATION OF PLATS.

In 1913 the winter wheats were grown in duplicate tenth-acre plats. The spring wheats and other spring cereals were grown in single tenth-acre plats. In 1914 all winter and spring cereals were grown in single tenth-acre plats except a few spring-wheat varieties, which

were grown in triplicate tenth-acre plats. In 1915 the winter-wheat varieties were grown in triplicate thirtieth-acre plats and most of the spring cereals in duplicate twentieth-acre plats.

PREPARATION OF THE LAND.

In the preparation of the seed bed the aim at Archer has been to do the work in as practical a manner as possible. However, at times the land has probably been given better preparation than would be profitable on the average farm.

All crops were grown on breaking in 1913 and on fallow land in 1914. In 1915 the winter wheats were grown on fallow and all spring crops on land which had produced corn the previous year.

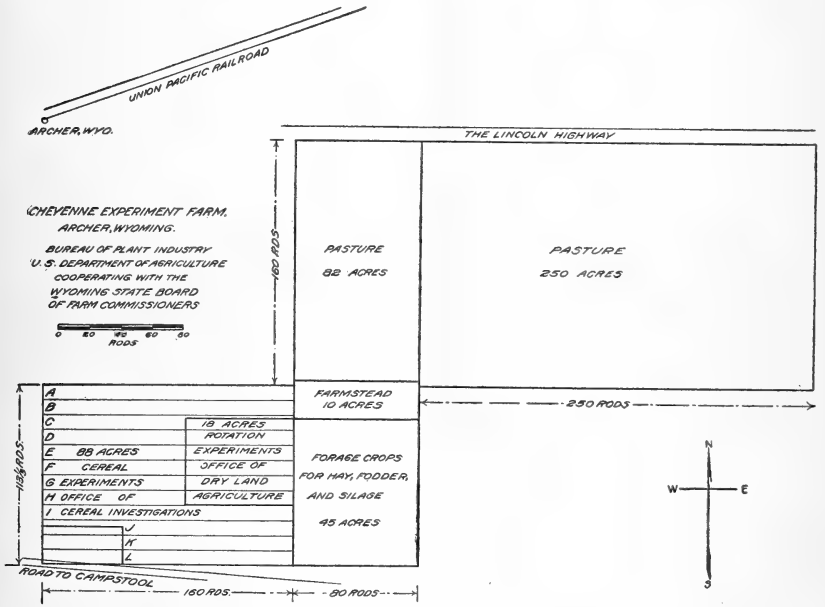

FIG. 5.—Map of the Cheyenne Experiment Farm, Archer, Wyo., showing the location of the principal experiments and the manner in which the farm is divided into series and plats.

RATES AND DATES OF SEEDING.

In the varietal experiments at Archer, winter and spring wheats have been seeded at the rate of 3 pecks per acre. The small-kerneled early oats have been sown at the rate of 4 pecks, and the larger kerneled midseason varieties at the rate of 5 pecks per acre. Barley has been sown at the rate of 4 pecks and flax at 15 pounds per acre.

Winter wheat, except in the fall of 1912, has been seeded between September 1 and 15. Spring wheat, oats, and barley have been sown between April 15 and May 1. Flax and proso have been seeded between May 15 and 25.

INTERPRETATION OF EXPERIMENTAL RESULTS.

The interpretation of the results obtained from plat experiments is difficult. This is due to the large number of factors which must be considered in determining the relative value of different varieties or different cultural methods. Generally speaking, the variety that gives the highest average yield of good quality in a period of several years is the one that should be grown. It is really quite difficult to obtain a variety that is consistently a high yielder and also is high in quality. Variations in soil and seasonal and annual variations in climate have a great influence on crop production in dry-land areas. All these factors must be thoroughly studied, in order that reliable conclusions may be drawn. The experiments at the Cheyenne Experiment Farm have been under way for only three years. This is too brief a period to give the needed long-time average of yields or to permit sufficient study of soil and climatic variations.

EXPERIMENTS WITH WHEAT.

At Archer, experiments with winter and spring varieties of wheat have been conducted in field plats and nursery rows. Most of the work, however, has been done on field plats. Wheat is the leading crop in southeastern Wyoming. Spring and winter varieties are grown on about equal acreages. More work has been done at Archer with wheat than with any other cereal.

WINTER WHEAT.

Experiments with winter wheat have included varietal, rate-of-seeding, and date-of-seeding experiments. The work at Archer is relatively new. Therefore little has been done in the improvement of crop varieties. The work has been confined for the most part to the testing of varieties known to be the most promising for the dry-land districts.

VARIETAL EXPERIMENTS.

The varietal experiments with winter wheat on the Cheyenne Experiment Farm have included for the most part the hard, red winter varieties of the Crimean group. Seven varieties have been grown for three years, 1913, 1914, and 1915, while eight additional varieties have been grown for two years, 1914 and 1915. The annual and average yields of winter-wheat varieties are presented in Table VI.

In 1913, seven winter-wheat varieties and strains were grown in duplicate tenth-acre plats on sod that was broken in August, 1912, double disked twice, and harrowed. The plowing was poorly done and the seed bed was rather rough. The seed was sown on October 5, 1912. The plants emerged on October 25, but made little growth before winter. The stands obtained were rather thin, but tillered

enough the next spring to make fair yields. The rainfall during the growing season was below normal.

In 1914, 15 varieties and strains of winter wheat were grown in tenth-acre plats on fallow land. The land was plowed in the fall of 1912 and left rough until the spring of 1913, when it was double-disked and kept free from weeds during the summer. The varieties were sown September 9, 1913. The fall of 1913 was wet, and good stands of all varieties were obtained. The winter wheats were 3 to 6 inches high when winter began. The winter was cold and open, and practically all varieties winterkilled considerably. A few plats apparently were favorably located, and on these the winter survival was much higher than on the others. The winterkilling was not uniformly distributed on the plats, but occurred in patches or streaks. The survival of a variety did not necessarily indicate winter hardiness, since the same variety sown on different plats had a markedly different winter survival. However, certain soft winter wheats less hardy than those of the Crimean group were entirely winterkilled. It is believed that the yields reported in Table VI are representative of what could reasonably have been expected from winter wheat on fallow land in 1914, as winterkilling was quite general on farms in the vicinity. The precipitation for the growing season was below normal, as shown in Table I.

TABLE VI.—*Annual and average yields of varieties of winter wheat grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Yield per acre (bushels).				
					Average.	
		[a] 1913	1914	[b] 1915	3 years, 1913 to 1915.	2 years, 1914 and 1915.
Crimean:						
Kharkof	1442	9.8	4.7	37.1	17.2	20.9
Crimean	1559	9.7	3.2	38.6	17.2	20.9
Do	1432	9.5	4.7	36.1	16.8	20.4
Turkey	1571	10.0	[c] 7.9	32.0	16.6	20.0
Malakoff	2908	10.3	0	37.6	16.0	18.8
Crimean	1437	9.2	2.5	35.1	15.6	18.8
Turkey	2998	.....	13.7	32.5	.....	23.1
Alberta Red	2979	.....	7.7	37.8	.....	22.8
Beloglina	1543	.....	5.0	36.8	.....	20.9
Kharkof	1583	.....	6.0	35.6	.....	20.8
Armavir	1355-2-2	.....	4.0	32.6	.....	18.3
Miscellaneous:						
Ghirka Winter	1438	9.3	7.8	37.6	18.2	22.7
Diehl Mediterranean	1359	.....	4.5	38.0	.....	21.3
Buffum No. 17	3330	.....	12.8	27.1	.....	20.0
Red Russian	1532	.....	5.6	32.8	.....	19.2

[a] Average of 2 tenth-acre plats.
[b] Average of 3 thirtieth-acre plats.
[c] Average of 3 tenth-acre plats (checks).

For the 1915 crop the winter wheat varieties were sown on September 8, 1914, in triplicate on thirtieth-acre plats. They were sown on fall-plowed fallow land that had been kept free from weeds during

the summer of 1914. The stands obtained and growth made before winter were good. The winter survival was high. The seasonal rainfall was considerably above normal, while the temperature was below normal during the growing season. The varieties yielded very well in 1915, as is shown in Table VI.

Table VII shows the agronomic data for seven varieties of winter wheat grown at Archer in the three years 1913, 1914, and 1915. These data include average dates of heading and maturity, height, weight per bushel, yield of grain and of straw, and ratio of grain to straw. The weight per bushel is for the two years 1914 and 1915. The weight per bushel was low in 1914, the grain being shrunken. The highest average yield, 18.2 bushels per acre, was produced by the

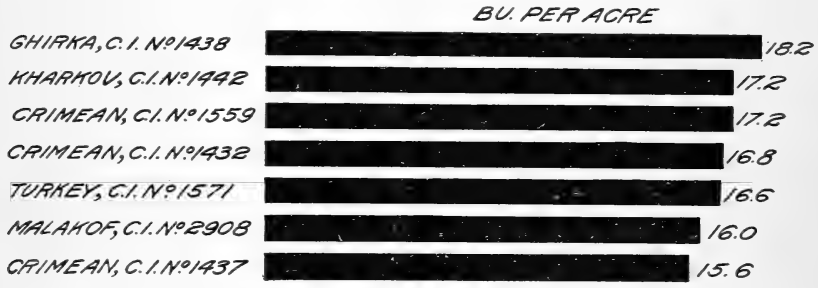

FIG. 6.—Diagram showing the average yields of seven varieties of winter wheat on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.

Ghirka Winter wheat (C. I. No. 1438). The lowest average yield, 15.6 bushels, was obtained from the Crimean (C. I. No. 1437). The ratio of grain to straw was lowest for Ghirka Winter and highest for Crimean (C. I. No. 1432). The average ratio for the seven varieties is about 1:2. In figure 6 the yields of the seven varieties of winter wheat grown at Archer from 1913 to 1915, inclusive, are shown graphically.

TABLE VII.—*Average date of heading and maturity, height, weight per bushel, yields, and ratio of grain to straw of seven varieties of winter wheat grown on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.*

Group and variety.	C. I. No.	Dates of—		Height.	Weight per bushel.[1]	Yield per acre.		Ratio, grain to straw.
		Heading.	Maturity.			Grain.	Straw.	
Ghirka:				*Inches.*	*Pounds.*	*Bush.*	*Pounds.*	
Ghirka Winter	1438	June 29	July 28	27	61	18.2	2,018	1:1.85
Crimean:								
Kharkof	1442	...do....	July 26	28	58	17.2	2,170	1:2.10
Crimean	1559	...do....	...do....	28	60	17.2	1,847	1:1.79
Do	1432	July 2	July 30	26	60.5	16.8	2,463	1:2.44
Turkey	1571	June 29	July 26	28	60	16.6	2,040	1:2.05
Malakoff	2908	[1] July 2	[1] July 31	[1] 30	62	16.0	1,769	1:1.84
Crimean	1437	June 29	July 27	27	58.5	15.6	1,804	1:1.93

[1] Average for two years.

The leading varieties of winter wheat, with the exception of the Ghirka Winter, belong to the Crimean group. The Ghirka Winter is a beardless variety with white, glabrous chaff and hard, red kernels. The Crimean group is characterized by bearded heads with white, glabrous chaff and hard, red kernels. Turkey is the leading variety on the farms in this section of Wyoming. A plat of Turkey winter wheat on the Cheyenne Experiment Farm is shown in figure 7.

RATE-OF-SEEDING EXPERIMENT.

A rate-of-seeding experiment has been conducted at the Cheyenne Experiment Farm since 1913 with two varieties of winter wheat. The rates of seeding have ranged from 2 to 7 pecks per acre. The

FIG. 7.—A plat of winter wheat on disked corn land on the Cheyenne Experiment Farm, 1915. (Photograph lent by the Office of Dry-Land Agriculture Investigations.)

annual and average yields in the rate-of-seeding test of the Turkey and Ghirka Winter wheats are shown in Table VIII.

TABLE VIII.—*Annual and average yields of the Turkey and Ghirka Winter wheats in a rate-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Variety and rate of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
Turkey:	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
2 pecks			0	0	32.5	4,070		
3 pecks	9.1	715	0	0	35.5	4,990	14.9	1,902
4 pecks	9.0	585	0	0	32.0	4,540	13.7	1,708
5 pecks	10.1	830	0	0	34.8	5,030	15.0	1,953
6 pecks	10.4	750	0	0	35.1	5,090	15.2	1,947
7 pecks	9.9	680	0	0				
Ghirka Winter:								
2 pecks			0	0	35.8	4,700		
3 pecks	9.3	600	0	0	35.5	5,080	14.9	1,893
4 pecks	7.4	450	0	0	32.8	5,130	13.8	1,860
5 pecks	8.6	595	0	0	31.3	5,040	13.3	1,878
6 pecks	9.3	650	0	0	30.5	4,920	13.3	1,890
7 pecks	7.5	750	0	0				

In 1913 the sowings were in tenth-acre plats on land that was plowed in August, double disked twice, and harrowed before seeding. The sowings were made on October 5, 1912. Little or no winterkilling occurred. The seasonal rainfall was below normal and the yields were relatively low. With the Turkey the highest yields were obtained from the 5-peck and 6-peck rates, while with the Ghirka Winter the 3-peck and 6-peck rates gave the highest yields.

In 1914 the two varieties were again grown in tenth-acre plats on fallow land. The seed was sown on September 10, 1913. There was sufficient moisture present in the soil to start germination immediately and a good fall growth resulted. The winter was cold and open, and as a result all rate sowings were so badly winterkilled that the plats were reseeded to spring crops.

In 1915 the rate-of-seeding test included rates of 2 to 6 pecks per acre. Sowings were made on September 9, 1914, in triplicate thirtieth-acre plats on fallow land. The stands obtained were good and an excellent fall growth resulted. All plats had a high winter survival and the yields were high. The 3-peck and 6-peck rates gave the highest yields with the Turkey wheat, while with the Ghirka Winter there was a gradual decrease in yield as the rate of seeding increased.

The average yields for the three years, 1913 to 1915, inclusive, are shown in Table VIII. With the Turkey, the highest average yields were obtained from the 3-peck, 5-peck, and 6-peck rates of seeding. The differences in yields from these rates were very small. With the Ghirka Winter the highest average yield was obtained from the 3-peck rate of seeding. Light seeding probably is to be preferred. It is the practice on the farms to sow about 3 pecks per acre in this section.

DATE-OF-SEEDING EXPERIMENTS.

Date-of-seeding experiments with the Turkey and Ghirka Winter wheats have been conducted since 1913. The annual and average yields obtained from the date-of-seeding tests are shown in Table IX.

In 1913 the sowings were in tenth-acre plats on breaking. The highest yields were from the earlier sowings. In 1914 the sowings were in tenth-acre plats on fallow land. Better stands and better fall growth were obtained from the earlier sowings. Winterkilling was severe on all plats. The plats of both varieties sown September 1 survived the winter best and were harvested. The plats sown on other dates were reseeded to spring crops.

In 1915 the sowings were in triplicate thirtieth-acre plats on fallow land. Good stands and excellent fall growth were obtained from the three earlier seedings. From the two later seedings fair stands

were obtained, but there was very little fall growth. The plats of the Turkey wheat sown on September 1 and 15 gave the highest yields. With Ghirka Winter, the plats sown on September 1 and 15 and October 1 all yielded practically the same. The September 15 sowing gave slightly the highest yield. The results to date seem to indicate that early seeding (September 1 to 20) is to be preferred, provided conditions are favorable to germination and fall growth. The farmers in this section practice early seeding when possible.

TABLE IX.—*Annual and average yields of the Turkey and Ghirka Winter wheats in a date-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Variety and date of seeding.	Yield per acre.									
	1913		1914		1915		Average.			
							1913 to 1915		1914 and 1915	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
Turkey:	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
Aug. 15	.....	.....	0	0	29.6	3,400	.....	.....	14.8	1,700
Sept. 1	.....	.....	6.8	1,145	38.1	4,460	.....	.....	22.5	2,802
Sept. 15	.....	.....	0	0	38.8	4,430	.....	.....	19.2	2,215
Oct. 1	8.8	635	0	0	34.5	3,140	14.4	1,258	17.2	1,570
Oct. 15	8.5	673	0	0	25.6	2,220	11.4	964	12.8	1,110
Nov. 1	6.7	455	0	0	.....	.....	.....	.....	.....	.....
Ghirka Winter:										
Aug. 15	.....	.....	0	0	27.0	2,970	.....	.....	13.5	1,485
Sept. 1	.....	.....	7.8	910	29.3	3,630	.....	.....	18.6	2,270
Sept. 15	.....	.....	0	0	31.3	4,140	.....	.....	15.7	2,070
Oct. 1	8.4	505	0	0	30.1	3,070	12.8	1,192	15.0	1,535
Oct. 15	8.4	545	0	0	17.1	1,690	8.5	745	8.5	845
Nov. 1	6.1	390	0	0	.....	.....	.....	.....	.....	.....

SPRING WHEAT.

Spring wheats are grown as extensively in eastern Wyoming as winter wheats. A greater number of varieties of spring wheat than of winter wheat have been tested at the Cheyenne Experiment Farm. Thirty-three varieties and strains have been included in the experiments during the three years, 1913, 1914, and 1915. The annual and average yields of these varieties are shown in Table X.

These varieties may be divided into two classes, common and durum. These classes may be separated further into groups. Eighteen of the varieties are common wheats and 15 are durum wheats. These two classes of wheat and the most important groups of each which are represented in the Great Plains area may be separated by the following descriptive key:[1]

[1] Ball, C. R., and Clark, J. A. Varieties of hard spring wheat. U. S. Dept. Agr., Farmers' Bul. 680, p. 6, 9, 18. 1915.

Descriptive key to varieties of spring wheat.

Heads rather slender, beardless or beards less than 3 inches long; spikelets far apart, scarcely overlapping, wide when seen in face view ..... COMMON WHEAT.
- Heads beardless:
  - Chaff white, glabrous ..... 1. Fife.
  - Chaff white, pubescent ..... 2. Bluestem.
- Heads bearded:
  - Chaff white, glabrous ..... 3. Preston.

Heads rather stout, all bearded, beards 4 to 8 inches long; spikelets close together, much overlapping, narrow when seen in face view ..... DURUM WHEAT.
- Chaff yellowish:
  - Chaff glabrous—
    - Beards yellow ..... 1. Kubanka.
    - Beards black ..... 2. Pelissier.
  - Chaff pubescent—
    - Beards black ..... 3. Velvet Don.
- Chaff black:
  - Chaff slightly pubescent—
    - Beards black ..... 4. Kahla.

VARIETAL EXPERIMENTS.

The varietal experiments with spring wheat are reported here in two separate series. The first contains the varieties grown in the regular varietal test. The second contains some lots obtained from the Minnesota experiment station in the spring of 1913, too late for inclusion in the regular series. All except one were discarded at the end of 1915. They were not grown in any of the three years on plats comparable in size with those of the regular series. The annual and average yields of the 33 varieties and strains of spring wheat grown in the regular varietal test in 1913, 1914, and 1915 are shown in Table X.

In 1913 the varieties of spring wheat included in Table X were sown on April 25 and 26 in tenth-acre plats on land that was broken in October, 1912. It lay in the rough until the spring of 1913, when it was double disked and harrowed before seeding. Good stands were obtained of practically all varieties. The spring was rather cold and late. Precipitation during the growing season was below normal, as is shown in Table II. A hailstorm on June 19 damaged the varieties slightly. The yields in 1913 ranged from 1.3 bushels from Crossbred (C. I. No. 3695) to 9.4 bushels from Erivan (C. I. No. 2397). The average yield of the 14 durum varieties was 7.7 bushels, while that of the 18 common spring varieties was 6.3 bushels per acre. The best variety of durum wheat yielded 8.8 bushels, 1.4 bushels less than the best common wheat.

In 1914 the spring-wheat varieties were sown on April 21 and 22 in tenth-acre plats on spring-plowed fallow land. Good stands were obtained on all plats. The spring was late, cool, and wet. The precipitation for the growing season was below normal. A hailstorm on June 14 damaged the spring wheat to some extent. During both 1913 and 1914 the crop prospects were excellent until about June 1, when the crops began to suffer from drought. The yields in 1914, as shown in Table X, ranged from 3.1 bushels per acre for Crossbred (C. I. No. 3695) to 13 bushels per acre for Kubanka (C. I. No. 1516). The average yield of the 14 durum varieties was 12 bushels, while the average yield of the 18 spring common varieties was 8.9 bushels per acre. The best variety of durum yielded 13 bushels, or 2.6 bushels more than the best common wheat.

TABLE X.—*Annual and average yields of 33 varieties and strains of spring wheat grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	[a]1915	3-year average.
COMMON WHEATS.					
Preston:					
Erivan	2397	9.4	9.5	22.0	13.6
Red Russian	4141	8.3	10.2	19.0	12.5
Spring Turkey	4154	8.7	8.5	19.5	12.2
Common Spring	1541	7.2	9.3	19.3	11.9
Preston	3698	6.7	9.8	15.3	10.6
Do	3081	4.7	8.1	14.8	9.2
Unclassified:					
Galgalos	2398	[b]7.9	[c]10.3	21.2	13.1
Defiance	3703	7.7	9.3	9.5	8.8
Fife:					
Cole Hybrid	4062	8.5	10.4	19.7	12.9
Marquis	3641	9.0	[c]8.4	20.9	12.8
Ghirka Spring	1517	[b]9.2	[c]10.0	13.2	10.8
Rysting	3022	8.3	8.1	11.7	9.4
Glyndon (Minn. No. 163)	2873	[b]5.8	9.6	12.5	9.3
Power	3697	4.7	7.3	12.3	8.1
Bluestem:					
Haynes (Minn. No. 169)	2874	[b]4.4	[c]9.0	11.7	8.4
Marvel	3082	3.4	6.5	11.2	7.0
Haynes	3021	2.6	5.3	10.7	6.2
Crossbred	3695	1.3	3.1	9.0	4.5
DURUM WHEATS.					
Kubanka:					
Beloturka	1520	7.7	11.9	28.9	16.2
Kubanka	1516	7.1	13.0	27.6	15.9
Pererodka	1350	8.3	12.8	26.0	15.7
Kubanka	1440	7.5	12.5	25.6	15.2
Yellow Gharnovka	1444	7.8	11.5	25.9	15.1
Gharnovka	1447	7.5	12.3	24.1	14.6
Arnautka	1493	[d]7.2	[e]12.3	23.8	14.4
Kubanka	1354	7.7	12.8	22.1	14.2
Marouani	1593	7.9	[c]11.5	21.5	13.6
Arnautka	4064	[b]6.4	10.7	23.6	13.6
Pelissier:					
Pelissier	1584	[b]8.7	[c]11.6	22.6	14.3
Saragolla	2228	6.7	10.3	18.8	11.9
Velvet Don:					
Velvet Don	1445	8.6	10.8	24.4	14.6
Kahla:					
Purple	3024	[b]7.5	[c]10.5	22.8	13.6
Blé dur	1471	7.3	11.8	[f]13.1	10.7

[a] Average of 2 twentieth-acre plats.
[b] Average of 2 tenth-acre plats.
[c] Average of 3 tenth-acre plats.
[d] Average of 15 check plats.
[e] Average of 12 check plats.
[f] Severely rogued.

In 1915 the spring-wheat varieties were sown April 27 and 28 and May 4 in duplicate twentieth-acre plats. These were on corn stubble that had been double disked and harrowed once previous to seeding. Good stands were obtained on all plats. The spring was late, cool, and wet. The precipitation during the growing season was considerably above normal, due to the high precipitation of April. The entire growing season was cool and favorable to crop growth. Hailstorms on July 5 and August 17 probably did some damage to the spring wheats. However, the most serious damage was due to rust, which affected all the spring common varieties. The lowest yield in 1915 was 9 bushels, from Crossbred (C. I. No. 3695), and the highest 28.9 bushels per acre, from Beloturka (C. I. No. 1520). The average yield of the 15 durum varieties was 23.4 bushels, while the average yield of the 18 spring common varieties was 15.2 bushels per acre.

Table XI shows the rank of the groups of spring wheats when arranged according to yields to be as follows: (1) Durum, (2) Preston, (3) unclassified (4) Fife, and (5) Bluestem. Table XI also shows certain agronomic data, including the average dates of heading and maturity, height, weight per bushel, yield, and the ratio of grain to straw, for the leading varieties of spring wheat grown on the Cheyenne Experiment Farm from 1913 to 1915, inclusive.

TABLE XI.—*Average dates of heading and maturity, height, weight per bushel, yields, and ratio of grain to straw, for 16 varieties of spring wheat grown on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.*

Group and variety.	C. I. No.	Date of—		Height.	Weight per bushel.[1]	Yield per acre.		Ratio, grain to straw.
		Heading.	Maturity.			Grain.	Straw.	
				Inches.	*Lbs.*	*Bush.*	*Lbs.*	
Durum:								
Beloturka	1520	July 13	Aug. 18	28	62.0	16.2	1,215	1 : 1.25
Kubanka	1516	...do....	Aug. 17	27	61.5	15.9	1,222	1 : 1.28
Pererodka	1350	...do....	Aug. 18	29	62.0	15.6	1,395	1 : 1.49
Kubanka	1440	...do....	...do....	27	61.7	15.2	1,197	1 : 1.31
Preston:								
Erivan	2397	July 15	Aug. 15	21	58.0	13.6	1,188	1 : 1.46
Red Russian	4141	July 16	Aug. 16	24	58.0	12.5	1,273	1 : 1.70
Spring Turkey	4154	July 17	Aug. 17	25	60.0	12.2	1,240	1 : 1.69
Unclassified:								
Galgalos	2398	July 15	Aug. 16	22	59.2	13.1	983	1 : 1.25
Defiance	3703	July 18	Aug. 18	25	53.2	8.8	1,063	1 : 2.01
Fife:								
Cole Hybrid	4062	July 17	...do....	27	58.5	12.9	1,268	1 : 1.64
Marquis	3641	July 15	Aug. 16	24	58.5	12.8	1,056	1 : 1.37
Ghirka Spring	1517	July 14	...do....	25	56.5	10.8	1,015	1 : 1.57
Rysting	3022	July 20	Aug. 18	25	54.2	9.4	1,297	1 : 2.30
Glyndon (Minn. No. 163)	2873	July 18	Aug. 19	23	55.7	9.3	1,221	1 : 2.19
Bluestem:								
Haynes (Minn. No. 169)	2874	...do....	...do....	24	51.0	8.4	1,095	1 : 2.17
Marvel	3082	July 21	Aug. 21	25	53.5	7.0	1,147	1 : 2.73

[1] Average for two years.

The durum wheats have headed earlier than the spring common wheats, but have been a little later in maturing than the leading varieties of common wheat. The durum varieties also have grown taller, weighed more per measured bushel, yielded higher, and given a higher ratio of grain to straw than the spring common varieties.

The yields of the leading varieties of each group are shown graphically in figure 8.

MISCELLANEOUS MINNESOTA VARIETIES.

Eleven lots of Fife, Bluestem, and Preston wheats were obtained from the Minnesota Agricultural Experiment Station late in the spring of 1913. They were sown in fiftieth-acre plats on breaking. The stands were good, except that of McKendry (C. I. No. 4147). These wheats were shattered about 15 per cent by hail on August 16. All were late in maturing and the yields were low.

In 1914 these wheats were sown on fallow land in plats of varying size. Good stands were obtained. Yields were better in 1914 than in 1913.

In 1915 the wheats were sown in single twentieth-acre plats on double-disked corn ground. The stands obtained were good. While

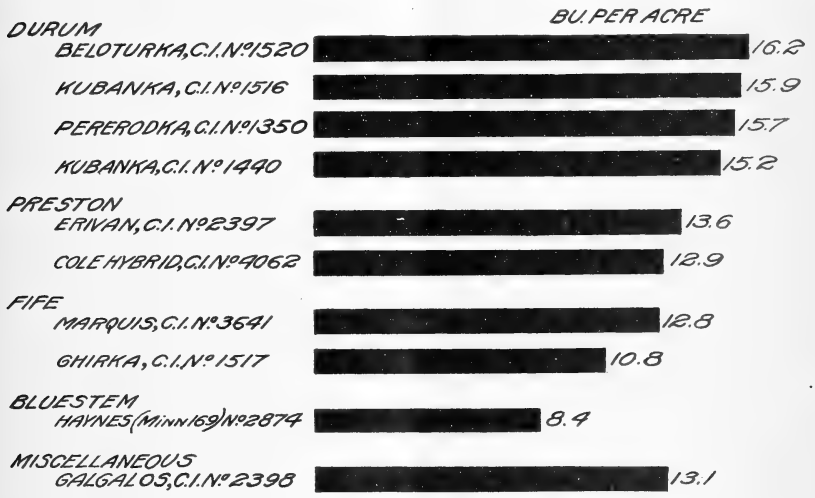

FIG. 8.—Diagram showing the average yields of the leading varieties in each group of spring wheat on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.

the varieties were damaged by rust, the yields obtained were fairly good, as is shown in Table XII, but the quality was poor. The average yields of these wheats in the three years, 1913 to 1915, inclusive, are much lower than those obtained from most of the varieties in the regular varietal test (Table X).

LEADING VARIETIES.

The leading durum wheats have yielded from 2 to 3 bushels per acre more than the leading common wheats. Yields from the leading varieties of the Preston, Fife, and miscellaneous groups have been practically the same. The Bluestem varieties have been consistently the lowest in yield.

TABLE XII.—*Annual and average yields of 11 spring common wheats from Minnesota grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Minn. No.	Yield per acre (bushels).			
			1913	1914	1915	3-year average.
Preston:						
Velvet Chaff	4153	1011	1.3	6.9	15.0	7.7
Fife:						
Glyndon	4143	163	2.0	3.7	9.3	5.0
Do	4146	285	1.5	4.1	10.3	5.3
McKendry	4147	288	4.0	[a] 7.3	9.7	7.0
Do	4152	903	2.5	4.2	10.7	5.8
Power	4150	886	.4	[a] 8.3	9.3	6.0
Do	4151	899	1.3	4.6	11.0	5.6
Rysting	4148	476	2.2	4.1	10.3	5.5
Wellman	4144	165	3.0	7.0	12.7	7.6
Bluestem:						
Bolton	4142	146	.6	4.6	10.0	5.1
Haynes	4145	169	.6	[a] 9.5	11.3	7.1

[a] Damaged by hail.

The leading varieties of durum wheat at Archer belong to the Kubanka group. This group of durums has broad heads with long, pale awns, yellowish, glabrous glumes, and large, hard, amber kernels. The Beloturka, Kubanka, and Pererodka varieties have given the highest average yields.

The spring common wheats grown at Archer are divided into four groups. The Preston group has bearded heads, white glabrous glumes, and hard red kernels. The Fife group has beardless heads, white glabrous glumes, and hard red kernels. The bluestem group has beardless heads, white pubescent glumes, and hard red kernels. The unclassified group includes some varieties which do not belong in any of the three groups just described. The Galgalos variety has a beardless head, brown pubescent glumes, and large soft white kernels. The Defiance has a beardless head, white glabrous glumes, and soft white kernels. The leading varieties in each of these groups are shown in Table XI.

RATE-OF-SEEDING EXPERIMENT.

A rate-of-seeding experiment with Arnautka durum wheat has been conducted at the Cheyenne Experiment Farm for three years, 1913 to 1915, inclusive. The annual and average yields obtained are shown in Table XIII.

In 1913 the rate-of-seeding test was sown in tenth-acre plats on breaking. Good stands were obtained from all rates. The highest yield was obtained from the 2-peck rate.

In 1914 the rate-of-seeding test was sown in tenth-acre plats on fallow land that had been spring plowed. Good stands were obtained. The highest yield was produced on the plat sown at the rate of 4 pecks per acre.

In 1915 the rate-of-seeding test was sown in duplicate twentieth-acre plats on double-disked corn ground. The highest yield was ob-

tained from the 2-peck rate. For the three years, the 2-peck rate of seeding gave the highest average yield. However, there is little difference in the average yields at the 2-peck, 3-peck, and 4-peck rates.

TABLE XIII.—*Annual and average yields of Arnautka durum wheat in a rate-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Rate of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush.	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
2 pecks	10.0	625	9.5	1,220	26.4	2,180	15.3	1,342
3 pecks	9.2	800	10.3	1,060	24.3	2,140	14.6	1,333
4 pecks	8.4	725	10.8	985	26.1	2,120	15.1	1,277
5 pecks	8.3	660	8.6	1,070	24.9	2,100	13.9	1,277
6 pecks	7.8	610	9.2	1,050	23.8	1,950	13.6	1,203
7 pecks	6.0	505	10.5	970	25.3	2,040	13.9	1,172

DATE-OF-SEEDING EXPERIMENT.

A date-of-seeding experiment with Spring Turkey common wheat has been conducted at the Cheyenne Experiment Farm during the three years, 1913, 1914, and 1915. The annual and average yields obtained in this test are shown in Table XIV.

TABLE XIV.—*Annual and average yields of Spring Turkey common wheat in a date-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Date of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
Apr. 15	[a] 16.7	850	8.3	890	15.8	1,890	13.7	1,210
May 1	9.3	625	8.6	935	16.5	1,680	11.5	1,080
May 15	9.1	750	6.4	765	12.8	1,830	9.4	1,115

[a] Computed yield.

In 1913 the date-of-seeding test was sown in tenth-acre plats on fall-plowed breaking. The stands obtained were good. The earlier date of seeding gave the highest yield. The drill failed to sow a portion of the plat sown on April 15. The portion actually seeded, one-fifteenth of an acre, was harvested, and the yield computed on a tenth-acre basis.

In 1914 the date-of-seeding test was sown in tenth-acre plats on spring-plowed fallow land. Stands were good. The highest yield was obtained from the May 1 seeding.

In 1915 the test was sown in duplicate twentieth-acre plats on double-disked corn ground. The highest yield was obtained again

from the May 1 seeding. The results to date indicate that fairly early spring sowing is to be preferred.

COMPARISON OF WINTER AND SPRING WHEATS.

In comparing the results from winter wheats, durum wheats, and spring common wheats it is observed that (1) better yields were obtained in 1913 from winter wheats, yet the difference in yield of the leading varieties of winter and spring wheat was not very great. (2) Better yields were obtained in 1914 from the spring wheats, the winter wheats being severely winterkilled. (3) In 1915 winter-wheat yields were much higher than those of spring wheat. (4) The average yields of the winter wheats in the years 1913, 1914, and 1915 are higher than those of any of the spring-wheat groups. (5) Durum wheats stand next to winter wheat when ranked according to yield. (6) Winter wheats undoubtedly will give higher yields than spring wheats if winterkilling is not too severe.

The annual and average yields of some of the leading varieties of winter and spring wheats for the three years, 1913 to 1915, are shown in Table XV.

TABLE XV.—*Annual and average yields of the leading varieties of winter, durum, and spring common wheats grown on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.*

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	3-year average.
WINTER WHEAT.					
Ghirka:					
Ghirka Winter	1438	9.3	7.8	37.6	18.2
Crimean:					
Kharkof	1442	9.8	4.7	37.1	17.2
SPRING WHEAT.					
Durum:					
Beloturka	1520	7.7	11.9	28.9	16.2
Common:					
Erivan	2397	9.4	9.5	22.0	13.6
Galgalos	2398	[a] 7.9	[b] 10.3	21.2	13.1
Marquis	3641	9.0	8.4	20.9	12.8

[a] Average of 2 tenth-acre plats. [b] Average of 3 tenth-acre plats.

The average yields of winter and spring wheat are not strictly comparable, since the winter wheats were grown on fallow in 1915, while the spring wheats were grown on disked corn ground.

It appears that it may be more profitable to grow spring wheat, especially the durums, after corn if the corn crop is profitable for forage. It may be possible also to grow winter wheat after corn, but data are not available at present. More data must be obtained before it will be possible to say whether winter or spring wheat is the more profitable. The average yields of the leading varieties of each group of wheats are shown graphically in figure 9.

EXPERIMENTS WITH EMMER AND SPELT.

One variety each of winter and of spring emmer has been grown at Archer during the 3-year period, 1913 to 1915, inclusive.

WINTER EMMER.

Black Winter emmer has been tested each year. In 1912 a tenth-acre plat was sown and about 50 per cent survived the winter. This plat yielded at the rate of 14.2 bushels per acre. In 1913 several plats were seeded at different rates. The stands and fall growth were good on all plats, but the crop entirely winterkilled. In 1914 three twentieth-acre plats were sown to winter emmer at different rates. A fair stand was obtained and the winter survival was high. The average yield of the three plats was about 20 bushels per acre.

Winter emmer has not survived the winters as well as winter wheat and the yields have been much lower. Winter emmer evidently is not adapted to conditions on the high western plains. The average

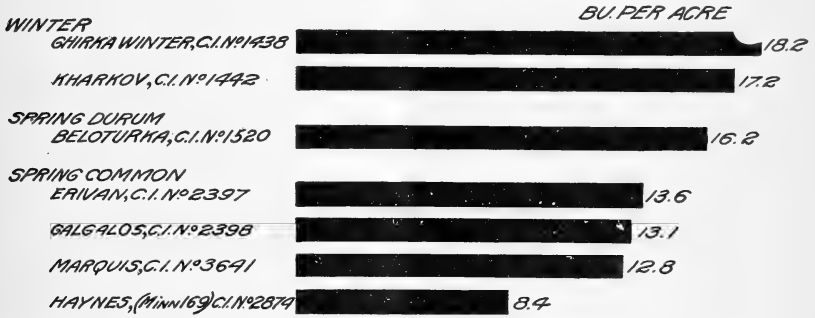

FIG. 9.—Diagram showing the average yields of the leading varieties of winter and spring wheat on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.

yields of emmer at the Cheyenne Experiment Farm have been lower than those of either spring oats or barley.

Winter emmer is drought resistant, but it is not nearly so hardy as the Crimean group of winter wheats. The data available indicate that Black Winter emmer is a doubtful crop in eastern Wyoming and growing it should not be encouraged at present.

SPRING EMMER.

White Spring emmer has been grown at Archer in each of the three years, 1913 to 1915, inclusive. In 1913 a tenth-acre plat was sown. The stand obtained was too thick and the growth was short. The plat yielded at the rate of 7.2 bushels per acre. In 1914 a tenth-acre fallow plat was sown. On this plat the stand was very thick and the growth was short, yielding at the rate of 13.4 bushels per acre. In 1915 three twentieth-acre plats were sown at the rate of 3, 4, and 5 pecks per acre on the barley scale. Under the favorable conditions

which prevailed, the 3-peck and 4-peck rates yielded 27 bushels and the 5-peck rate 28.5 bushels per acre. The average yield of the three plats was 27.5 bushels per acre. When compared with spring barley or oats it is seen that spring emmer has not yielded as well as either of these crops during the 3-year period.

WINTER SPELT.

Only one variety of winter spelt has been tested at Archer, and that for only one year. On September 11, 1913, a tenth-acre plat was sown to Red Winter spelt. A good stand and a fair fall growth resulted, but the plants were entirely winterkilled. Spelt will probably never be an important crop in this area.

EXPERIMENTS WITH OATS.

WINTER OATS.

Only one variety of winter oats has been tested at Archer. On September 11, 1913, a tenth-acre fallow plat was sown to the Boswell Winter variety. A good stand and a fair fall growth resulted. The plants were all killed, however, during the ensuing winter, and winter oats have not since been grown. Oats are much less winter hardy than wheat and there is no likelihood that they will succeed as a winter crop in this section of the Great Plains area.

SPRING OATS.

The value of the oat crop in Wyoming is greater than that of any other cereal. A large proportion of the crop is grown under irrigation. Fairly good yields are obtained on the dry lands, however.

VARIETAL EXPERIMENT.

Fifteen varieties of spring oats have been tested at the Cheyenne Experiment Farm during 1913, 1914, and 1915. The annual and average yields of these varieties are shown in Table XVI. The oat varieties were grown in tenth-acre plats on breaking in 1913, in tenth-acre plats on fallow in 1914, and in duplicate twentieth-acre plats on double-disked corn ground in 1915.

In 1913 the seed bed was poor, the summer dry, and yields low. The Sixty-Day (C. I. No. 165) was the highest yielding variety, with 15.8 bushels per acre. In 1914 the seed bed was good, the summer dry, and yields low. The Kherson (C. I. No. 459) was the highest yielding variety, with 27.5 bushels per acre. In 1915 the seed bed was good, the spring and summer wet, and yields good. The Abundance (C. I. No. 731) was the highest yielding variety, with a yield of 52.4 bushels per acre. Oats do best in a cool, moist climate, which accounts for their better yields in 1915.

TABLE XVI.—*Annual and average yields of 15 varieties of spring oats grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	[a] 1915	3-year average.
Early:					
Sixty-Day	165	15.8	25.6	[b] 29.9	23.7
Kherson	459	[c] 12.5	[c] 27.5	[b] 29.3	23.1
Perm	170	13.5	24.5	[b] 26.5	21.5
Midseason:					
Swedish Select	134	10.0	26.7	52.1	29.6
Colorado No. 37	619	7.2	24.7	51.5	27.8
Ligowo	492	10.5	23.6	48.7	27.6
Silvermine	714	11.3	22.5	47.2	27.0
Abundance	731	7.5	20.3	52.4	26.7
Probsteier	495	12.2	22.5	45.0	26.5
Siberian	741	5.7	21.3	47.2	24.7
Lincoln	738	5.0	21.3	45.0	23.7
National	767	8.3	19.7	39.3	22.4
Montana	769	7.8	21.4	33.1	20.7
Banner	732	5.8	13.9	32.4	17.3
Late:					
Black Tartarian	768	7.8	18.8	41.5	22.5

[a] Average of 2 twentieth-acre plats.
[b] Damaged about 30 per cent by hail.
[c] Average of 6 tenth-acre check plats.

Oat varieties are usually grouped into early, midseason, and late varieties. In Table XVII are presented the average data on dates

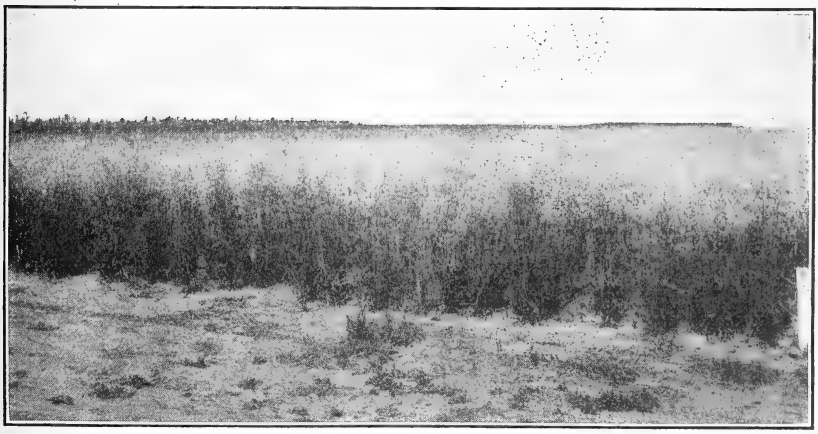

FIG. 10.—A plat of oats on spring plowing on the Cheyenne Experiment Farm in 1915. (Photograph lent by the Office of Dry-Land Agriculture Investigations.)

of heading and maturity, height, weight per bushel, yield per acre, and ratio of grain to straw for the leading varieties of each group at Archer during the 3-year period, 1913 to 1915, inclusive.

The early varieties gave better yields in 1913 and 1914 than the midseason or late varieties. In 1915, however, the midseason varieties gave the highest yields, the early varieties being damaged by hail. The average yields for three years show the midseason

varieties to be highest, the early varieties ranking second. The early varieties have matured about August 1 and the midseason and late varieties about August 14. The one late variety which was grown, Black Tartarian, usually ripened prematurely, so that the date recorded for it is earlier than normal. The early varieties averaged about 24 inches in height and the midseason and late varieties about 28 inches. The weights per bushel are for two years and are higher for the midseason and late varieties than for the early ones. However, all weights are above the legal standard of 32 pounds per bushel. The ratio of grain to straw is about 1 : 1 for the early varieties, while for the midseason varieties the ratio is about 1 : 1.35. A plat of early oats at the station is shown in figure 10. The yields from the leading varieties of each group are shown graphically in figure 11.

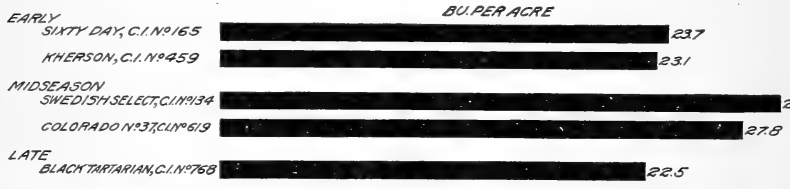

FIG. 11.—Diagram showing the average yields of five varieties of oats on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.

TABLE XVII.—*Average dates of heading and maturity, height, weight per bushel, yield, and ratio of grain to straw of eight varieties of oats grown on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.*

Group and variety.	C. I. No.	Date of—		Height.	Weight per bushel.[1]	Yield per acre.		Ratio, grain to straw.
		Heading.	Maturity.			Grain.	Straw.	
Early:				*Inches.*	*Lbs.*	*Bush.*	*Lbs.*	
Sixty-Day	165	July 7	Aug. 1	23	34.5	23.7	805	1 : 1.06
Kherson	459	...do	July 31	24	33.5	23.1	715	1 : .97
Midseason:								
Swedish Select	134	July 20	Aug. 13	28	36.5	29.6	1,230	1 : 1.30
Colorado No. 37	619	July 21	Aug. 14	25	37.7	27.8	1,120	1 : 1.26
Ligowo	492	...do	...do	28	39.5	27.6	1,233	1 : 1.40
Silvermine	714	July 20	Aug. 12	28	37.2	27.0	1,063	1 : 1.23
Abundance	731	July 21	Aug. 16	28	37.0	26.7	1,065	1 : 1.25
Late:								
Black Tartarian	768	...do	Aug. 14	26	38.2	22.5	967	1 : 1.34

[1] Average for two years only.

The leading varieties of oats to date are the Swedish Select (C. I. No. 134) and Colorado No. 37 (C. I. No. 619) of the midseason group, and the Kherson (C. I. No. 459) and Sixty-Day (C. I. No. 165) of the early group. The Kherson and Sixty-Day were the leading varieties in 1913 and 1914, but were reduced in yield by hail in 1915. It is believed that these two varieties and the Swedish Select are the best ones to grow in eastern Wyoming.

RATE-OF-SEEDING EXPERIMENT.

A rate-of-seeding test with Kherson oats has been conducted at the Cheyenne Experiment Farm during the 3-year period, 1913 to 1915, inclusive. Plats have been sown each year at the rate of 3, 4, 5, 6, and 7 pecks per acre. The annual and average yields obtained in this test are shown in Table XVIII. Poor yields were obtained in 1913. The highest yield (16.6 bushels) was obtained from the plat sown at the rate of 3 pecks. In 1914 fair yields were obtained, the highest (28.7 bushels) being from the 6-peck rate. In 1915 good yields were obtained, the highest (50.2 bushels) being produced from the 6-peck rate. The average yield from this test shows an increase in yield as the rate of seeding increased. Indications are that 5 or 6 pecks per acre is about the right quantity to sow in southeastern Wyoming.

TABLE XVIII.—*Annual and average yields of Kherson oats in a rate-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Rate of seeding.	Yield per acre.									
	1913		1914		1915		Average.			
							1913 to 1915.		1914 and 1915.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush.	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
3 pecks	16.6	480	24.7	610	[a] 36.0	1,560	25.7	883	30.3	1,085
4 pecks	15.0	420	26.2	610	[a] 41.2	1,470	27.4	833	33.7	1,040
5 pecks	14.5	475	25.9	770	[a] 46.5	1,540	28.9	928	36.2	1,155
6 pecks	13.6	648	28.7	740	[b] 50.2	1,770	30.8	1,053	39.4	1,255
7 pecks	.....	.....	26.4	875	[b] 50.0	1,510	.....	.....	38.2	1,192

[a] Damaged about 20 per cent by hail. [b] Damaged about 5 per cent by hail.

DATE-OF-SEEDING EXPERIMENT.

A date-of-seeding test with Kherson oats has been conducted on the Cheyenne Experiment Farm during the three years, 1913 to 1915, inclusive, Sowings have been made each year on April 15, May 1, and May 15. The annual and average yields obtained from this test are shown in Table XIX. In 1913 the May 1 sowing, in 1914 the April 15 sowing, and in 1915 the May 15 sowing gave the highest yields. Thus in the three years each date of seeding has given the highest yield once. The highest average yield, as shown in Table XIX, has resulted from the early seeding. Oats should be sown early, between April 15 and May 1.

TABLE XIX.—*Annual and average yields of Kherson oats in a date-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Date of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush.	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*	*Bush.*	*Lbs.*
Apr. 15	7.5	260	28.7	730	[a]34.0	1,120	23.4	703
May 1	8.3	270	26.2	610	[b]33.4	1,150	22.6	677
May 15	7.0	638	22.5	670	[c]34.9	1,660	21.4	989

[a] Damaged about 3 per cent by hail.
[b] Damaged about 35 per cent by hail.
[c] Damaged about 10 per cent by hail.

EXPERIMENTS WITH BARLEY.

WINTER BARLEY.

Only one variety of winter barley has been tested at Archer, and that in only one year. On September 11, 1913, a tenth-acre plat was sown to White Club barley. A good stand and a fair fall growth resulted. The crop was entirely killed during the ensuing winter.

Winter barley is not nearly as hardy as winter wheat, and it is hardly probable that it can be grown successfully in the Great Plains area.

SPRING BARLEY.

Spring barley is grown quite extensively in Wyoming, both in irrigated and dry-farmed sections.

VARIETAL EXPERIMENTS.

At Archer 14 varieties of spring barley have been tested in the three years, 1913, 1914, and 1915. The annual and average yields of these varieties are shown in Table XX. In 1913 the barley varieties were grown in single tenth-acre plats on fall-plowed breaking, in 1914 in single tenth-acre plats on spring-plowed fallow, and in 1915 in duplicate twentieth-acre plats on double-disked corn ground. Good stands have resulted each year. In 1913 the summer was dry and yields low. The White Smyrna (C. I. No. 658) yielded best, 10 bushels per acre. In 1914 the growing season was dry and the yields low, although somewhat higher than in 1913. The White Smyrna (C. I. No. 658) again was the highest in yield, producing 16.3 bushels per acre. In 1915 the spring and summer rainfall was high and the yields good. For the third successive year the White Smyrna produced the highest yield, 38.3 bushels per acre.

TABLE XX.—*Annual and average yields of 14 varieties of spring barley on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Yield per acre (bushels).			
		1913	1914	1915	3-year average.
Two-rowed hulled:					
White Smyrna (Ouchac)	658	[a]10.0	16.3	38.3	21.5
Hannchen	531	[a]9.6	[a]16.0	34.1	19.9
Hanna	24	8.8	10.8	32.0	17.2
Primus	532	8.9	8.3	33.9	17.0
Smyrna	195	5.7	9.6	30.6	15.3
Blackhull	878	[b]3.5	14.8	[b]22.7	13.7
Six-rowed hulled:					
Coast	690	6.6	14.4	41.2	20.7
Manchuria (Minn. No. 6)	638	6.6	11.8	33.5	17.3
Horsford	877	6.3	14.5	26.6	15.8
Manchuria (Minn. No. 105)	354	7.2	9.6	30.2	15.6
Gatami	575	4.4	15.5	23.7	14.5
Six-rowed naked:					
Black Hull-less	1106	9.8	7.5	27.8	15.0
Baku	709	5.2	8.3	23.3	12.3
Nepal	595	4.6	8.0	23.8	12.1

[a] Average of 6 tenth-acre check plats. [b] Damaged by hail.

In Table XXI the average data are given on dates of heading and maturity, height, weight per bushel, yield, and ratio of grain to straw for eight barley varieties grown during the three years, 1913 to 1915, inclusive, at the Cheyenne Experiment Farm.

TABLE XXI.—*Average dates of heading and maturity, height, weight per bushel, yield and ratio of grain to straw of eight varieties of spring barley grown on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.*

Group and variety.	C. I. No.	Dates of—		Height.	Weight per bushel.	Yield per acre.		Ratio, grain to straw.
		Heading.	Maturity.			Grain.	Straw.	
				Inches.	*Pounds.*	*Bush.*	*Pounds.*	
Two-rowed hulled:								
White Smyrna (Ouchac)	658	July 12	Aug. 1	18	47.5	21.5	987	1 : 0.96
Hannchen	531	July 14	Aug. 9	19	49.7	19.9	1,002	1 : 1.05
Hanna	24	July 22	Aug. 8	19	48.7	17.2	1,163	1 : 1.41
Six-rowed hulled:								
Coast	690	July 8	Aug. 2	21	40.0	20.7	1,052	1 : 1.01
Manchuria (Minn. No. 6)	638	July 12	Aug. 3	22	40.7	17.3	1,047	1 : 1.26
Horsford	877	July 9	Aug. 2	24	38.7	15.8	948	1 : 1.25
Manchuria (Minn. No. 105)	354	July 10	Aug. 3	21	40.5	15.7	1,095	1 : 1.45
Six-rowed naked:								
Black Hull-less	1106	July 14	Aug. 8	19	61.2	14.9	1,012	1 : 1.13

The varieties of the 6-rowed group were fully headed about July 10, and those of the 2-rowed group about July 15. The 6-rowed group reached maturity about August 2, and the 2-rowed group about August 8. There has been little difference in the height attained by the different varieties. The 2-rowed varieties have tested considerably higher in weight per bushel than the 6-rowed hulled varieties. The 2-rowed group has yielded higher than either of the other groups. All varieties have produced about the same quantity of straw per acre.

The average yields of the eight varieties are shown graphically in figure 12.

The White Smyrna (Ouchac, C. I. No. 658), a 2-rowed hulled variety, has given the highest annual and average yields. The Hannchen (C. I. No. 531), also a 2-rowed variety, has yielded well. In the 6-rowed hulled group, the Coast (C. I. No. 690) has been the highest yielding variety, with the Manchuria (Minn. No. 6, C. I No. 638) second. In the 6-rowed naked group, the Black Hull-less (C. I. No. 1106) has yielded quite well. There has been less than

FIG. 12.—Diagram showing the average yields of the five leading varieties of spring barley on the Cheyenne Experiment Farm, 1913 to 1915, inclusive.

1 bushel difference in the yields of the White Smyrna and the Coast, the two leading varieties. The Hannchen has also yielded well, since the yields here presented are averages from several check plats of this variety in 1913 and 1914.

RATE-OF-SEEDING EXPERIMENT.

A rate-of-seeding experiment with the Svanhals barley has been conducted at the Cheyenne Experiment Farm during the 3-year period, 1913 to 1915, inclusive. In 1913, plats were sown at the rates of 2, 3, 4, and 5 pecks per acre. In 1914 and 1915 sowings were made at the rates of 2, 3, 4, 5, 6, and 7 pecks. The annual and average yields obtained in the rate-of-seeding tests are shown in Table XXII.

TABLE XXII.—*Annual and average yields of the Svanhals barley in a rate-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Rate of seeding.	Yield per acre.									
	1913		1914		1915		Average.			
							1913 to 1915.		1914 and 1915.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bush.	*Pounds.*	*Bush.*	*Pounds.*	*Bush.*	*Pounds.*	*Bush.*	*Pounds.*	*Bush.*	*Pounds.*
2 pecks	13.2	795	9.4	670	31.4	1,760	18.0	1,075	20.4	1,215
3 pecks	10.3	855	9.8	780	33.9	1,840	18.0	1,158	21.9	1,310
4 pecks	5.9	715	11.9	1,130	33.7	1,570	17.1	1,138	22.8	1,350
5 pecks	4.3	565	11.9	990	34.8	1,510	17.0	1,022	23.4	1,250
6 pecks	.....	.....	6.1	1,145	33.9	1,590	.....	.....	20.0	1,367
7 pecks	.....	.....	4.2	1,100	34.9	1,780	.....	.....	19.5	1,440

In 1913 the yields were low. The highest yield, 13.2 bushels per acre, was obtained from the 2-peck rate. In 1914 the highest yield, 11.9 bushels per acre, was obtained from the 4-peck and 5-peck rates. In 1915 the highest yield was 34.9 bushels per acre, obtained from the 7-peck rate, though the yield from the 5-peck rate was only slightly lower. The results to date show that a thin seeding of 2 to 4 pecks per acre has given the best average yields in the 3-year period.

DATE-OF-SEEDING EXPERIMENT.

A date-of-seeding experiment with the Svanhals barley has been conducted at the Cheyenne Experiment Farm during the 3-year period, 1913 to 1915, inclusive. Plats have been sown April 15, May 1, and May 15 each year. The annual and average yields obtained from this test are shown in Table XXIII.

TABLE XXIII.—*Annual and average yields of the Svanhals barley in a date-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Date of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
Apr. 15	9.9	610	14.4	760	31.2	1,580	18.5	983
May 1	12.0	835	10.5	705	34.3	1,650	18.9	1,063
May 15	7.6	675	5.7	795	40.3	1,980	17.8	1,150

Yields in 1913 and 1914 were low, with a slight advantage for the early seeding. In 1915 the yields were much higher, the May 15 seeding giving the highest yield, 40.3 bushels per acre. The average yields favor early seeding, between April 15 and May 1.

EXPERIMENTS WITH FLAX.

Flax is one of the common farm crops in eastern Wyoming, being grown quite extensively on the newly broken prairie. However, flax is not grown as extensively as results indicate that it should be.

VARIETAL EXPERIMENTS.

Fourteen varieties of flax have been grown on the Cheyenne Experiment Farm for a period of three years and two additional varieties for a period of two years. The annual and average yields obtained from these 16 varieties are shown in Table XXIV.

In 1913 the flax varieties were sown in tenth-acre plats on breaking at the rate of 15 pounds per acre. The seed was not well distributed by the drill, but fair stands resulted. The summer was rather dry, the precipitation in May and June being below normal. A fair growth was made and the yields ranged from 4.3 to 7.4 bushels per

acre. The Select Russian (C. I. No. 3) gave the highest yield, 7.4 bushels.

TABLE XXIV.—*Annual and average yields of 16 varieties and strains of flax grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Variety.	C. I. No.	Yield per acre (bushels).				
		1913	1914	1915	Average.	
					1913 to 1915.	1914 and 1915.
Montana Common	6	7.0	5.6	17.6	10.1	11.6
Select Russian (N. Dak. No. 1215)	3	7.4	5.2	17.2	9.9	11.2
Fargo Common (N. Dak. No. 1133)	18	6.3	5.6	17.5	9.8	11.6
Russian (N. Dak. No. 155)	19	5.5	4.5	18.0	9.3	11.3
Russian (N. Dak. No. 155)	17	5.0	5.9	16.3	9.1	11.1
North Dakota Resistant No. 52	8	6.3	6.7	12.8	8.6	9.8
Russian (N. Dak. No. 1340)	5	7.0	4.5	14.0	8.5	9.3
Wyoming Common	63	[a] 5.0	[b] 4.9	15.3	8.4	10.1
Select Riga (N. Dak. No. 1214)	2	6.4	5.0	13.3	8.2	9.2
North Dakota No. 1221	16	5.4	5.5	13.5	8.1	9.5
Russian (N. Dak. No. 1329)	4	6.3	5.7	12.0	8.0	8.9
Select Russian	1	6.3	4.9	12.5	7.9	8.7
Blue Blossom	22	4.6	5.5	11.5	7.2	8.5
Primost (Minn. No. 25)	12	4.3	5.9	10.8	7.0	8.4
Idaho Common	15	.....	4.4	18.5	.....	11.4
North Dakota Resistant No. 114	13	.....	3.8	12.5	.....	8.1

[a] Average of 5 tenth-acre check plats. [b] Average of 7 tenth-acre check plats.

In 1914 the flax varieties were sown in tenth-acre plats on spring-plowed fallow land at the rate of 15 pounds per acre. Good stands were obtained. The precipitation in June and July was below normal and was poorly distributed. However, fair yields of flax were obtained. The yields ranged from 3.8 to 6.7 bushels per acre.

In 1915, 16 flax varieties were sown in duplicate twentieth-acre plats on double-disked corn ground at the rate of 15 pounds per acre. Good stands were obtained. The spring and summer rainfall was above normal. The growing season was considerably prolonged by the cool, wet weather. The growth was good and excellent yields were obtained, ranging from 10.8 to 18.5 bushels per acre. The 3-year average yield of 14 flax varieties ranges from 7 to 10.1 bushels per acre.

The four leading varieties and their average yields are: Montana Common (C. I. No. 6), 10.1 bushels; Select Russian (N. Dak. No. 1215, C. I. No. 3), 9.9 bushels; Fargo Common (N. Dak. No. 1133, C. I. No. 18), 9.8 bushels; and Russian (N. Dak. No. 155, C. I. No. 19), 9.3 bushels per acre.

Flax is a promising crop for eastern Wyoming, as shown by the results in the past three years. Flax growing need not be confined to newly broken land, as good results can also be obtained on old land if the seed bed is well prepared and kept free from weeds. Flax should not be grown continuously on the same land but in rotation with other crops, preferably after a clean-cultivated row crop. It is imperative that flax be grown in rotation with other crops, in order that loss from flax diseases may be reduced to the minimum.

RATE-OF-SEEDING EXPERIMENT.

Russian flax (C. I. No. 19) was grown at the Cheyenne Experiment Farm in a rate-of-seeding experiment during 1914 and 1915. Plats were sown each year at the rate of 10, 15, 20, and 25 pounds per acre. The annual and average yields obtained in this test are shown in Table XXV.

TABLE XXV.—*Annual and average yields of Russian flax (N. Dak. No. 155) grown in a rate-of-seeding test on the Cheyenne Experiment Farm in 1914 and 1915.*

Rate of seeding.	Yield per acre.					
	1914		1915		2-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
10 pounds	4.3	640	14.9	1,380	9.6	1,010
15 pounds	4.7	675	17.1	1,310	10.9	992
20 pounds	6.0	545	14.9	1,280	10.4	912
25 pounds	4.5	580	14.2	1,200	9.3	890

Low yields were obtained in 1914, due to summer drought. The highest yield was 6 bushels per acre, obtained from the 20-pound rate of seeding. Fallow land was used in this test in 1914.

In 1915 the sowings were made in duplicate twentieth-acre plats on double-disked corn ground. The summer was cool and wet and the yields were high. The highest yield was obtained from the plat sown at the rate of 15 pounds per acre.

Two years' results in the rate-of seeding test indicate that 15 to 20 pounds per acre is about the right quantity to sow.

DATE-OF-SEEDING EXPERIMENT.

A date-of-seeding experiment with flax has been in progress at the Cheyenne Experiment Farm for three years. In 1913, tenth-acre plats were sown on three different dates, May 1, May 15, and June 1. The highest yield was 7 bushels, obtained from the plat sown on June 1. In 1914, tenth-acre plats were sown on four dates, as shown in Table XXVI. The highest yield was 5.4 bushels, obtained from the June 1 sowing. In 1915, duplicate twentieth-acre plats were sown on four dates. The highest yield resulted from the sowing made on June 1. The land on which this experiment has been conducted received the same preparation as that on which the varieties were grown. The annual and average yields obtained are shown in Table XXVI.

There has been a progressive increase in yield from the early to the late seedings each year. The soil is rather late in warming up at Archer, and the early sowings have grown more slowly and required a longer period to reach maturity than the plats sown as late as June 1. However, the early sowings mature more uniformly than the late ones.

If the fall is wet, late-sown plats may continue green until destroyed by frost. This condition was observed in the vicinity of Archer in the fall of 1913. It will require years of testing to determine the best date to sow flax. Until more definite data are available it appears that sowing between May 15 and June 1 will be satisfactory.

TABLE XXVI.—*Annual and average yields of Select Russian flax (N. Dak. No. 1215) grown in a date-of-seeding test on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Date of seeding.	Yield per acre.							
	1913		1914		1915		3-year average.	
	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.	Grain.	Straw.
	Bushels.	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*	*Bushels.*	*Pounds.*
Apr. 15	.....	.....	2.7	310	9.7	1,440	.....	.....
May 1	[a] 3.3	257	3.4	500	14.9	1,640	7.2	799
May 15	6.9	536	4.3	480	15.5	1,600	8.9	872
June 1	7.0	710	5.4	730	19.4	1,720	10.6	1,053

[a] Seeded too thick.

EXPERIMENTS WITH MINOR GRAIN CROPS.

The minor cereals, including proso, foxtail millet, grain sorghums, corn, and buckwheat, have been tested at the Cheyenne Experiment Farm during the 3-year period, 1913 to 1915, inclusive. Each of these cereals will be discussed briefly in the following paragraphs.

PROSO AND FOXTAIL MILLET.

Proso (broom-corn millet or hog millet) is grown for grain for feeding purposes, while foxtail millet is grown largely for hay. Proso is not grown extensively in eastern Wyoming, though it is fairly well adapted to the soil and climatic conditions prevailing in this district.

Eight prosos and two foxtail millets have been grown at the Cheyenne Experiment Farm during the 3-year period, 1913 to 1915, inclusive. The annual and average yields of the 10 millet varieties are shown in Table XXVII.

In 1913 the millets were grown in rows 132 feet long and spaced 3 feet apart on fall-plowed breaking. The summer was dry, but fair yields were obtained. In 1914 the millets were grown on fallow in twentieth-acre plats in rows 3 feet apart. The summer was dry and the yields obtained were low. In 1915 the millets were grown in twentieth-acre plats on double-disked corn ground. The yields obtained were low in spite of the better season.

The foxtail varieties have given higher average yields than the prosos. The proso yields have been materially reduced each year by shattering at and before harvest time. Birds are very fond of proso seed and have eaten large quantities before thrashing. A con-

siderable acreage of foxtail millet is grown each year in Wyoming for hay. When grown for hay, 8 to 10 pounds of seed are required to sow an acre. Sowing is done with a grain drill equipped with a grass-seeder attachment. The millet is cut for hay when fully headed and before it begins to ripen.

TABLE XXVII.—*Annual and average yields of eight prosos and two foxtail millets grown on the Cheyenne Experiment Farm in 1913, 1914, and 1915.*

Group and variety.	C. I. No.	Yield per acre.				
		Grain (bushels).				3-year average of straw.
		1913	1914	1915	3-year average.	
Proso:						*Pounds.*
Red Turghai	31	22.3	7.7	9.6	13.2	1,023
Proso	113	23.2	10.9	0	11.4	2,583
Red Russian	11	10.7	6.6	11.6	9.6	728
White Ural	4	11.3	3.2	11.2	8.4	883
Black Voronezh	16	[a] 7.2	[b] 6.7	10.8	8.2	1,021
Tambov	13	[a] 12.0	[b] 5.2	6.0	7.7	755
Red Lump	65	10.9	3.2	6.0	6.7	603
Red Voronezh	60	7.2	1.8	6.0	5.0	613
Foxtail millet:						
Kursk (South Dakota No. 78)	.....	14.8	16.3	[a] 29.5	20.2	1,613
Kursk (South Dakota No. 79)	.....	8.9	10.9	[a] 26.9	15.6	2,532

[a] Average of two plats. [b] Average of three plats.

GRAIN SORGHUM.

Several of the earliest maturing varieties of grain sorghum have been tested each year. These varieties have been grown in 8-rod rows spaced 42 inches apart. The sorghums have been cultivated two or three times each season and kept free from weeds. Nearly all varieties have headed each year, but none has produced seed in sufficient quantity to warrant thrashing.

Manchu kaoliang (C. I. No. 261) and white kafir (C. I. No. 370) have been the earliest varieties tested. A few practically mature heads were obtained from each of these varieties in 1913 and 1914.

The results from the work with grain sorghum clearly show that this crop can not be grown for grain in eastern Wyoming. However, some of the varieties compare favorably with corn and sorgo in the production of roughage for stock. The milos and kafirs have considerably more foliage than the kaoliangs and should be grown when feed is wanted.

CORN.

A few varieties of field corn have been tested each year. Fair to good forage yields have been obtained each season, but in none of the three years has any variety fully matured. However, the Northwestern Dent, Brown County Yellow Dent, and Gehu Flint have produced mature grain each season, or at least mature enough to germinate if properly stored until the following spring.

Corn appears to be a very uncertain crop for grain at high elevations in eastern Wyoming, according to the three years' results obtained at Archer. It is probably the best crop to grow for silage or roughage, however.

BUCKWHEAT.

Buckwheat has been grown on the Cheyenne Experiment Farm in each of the three years. Two varieties have been tested, the Tartarian and the Mountain. Neither of these varieties appears to be adapted to conditions such as prevail at Archer. Buckwheat is unable to withstand drought, and hence all yields obtained have been low, except in 1915, a season of high rainfall. The Tartarian is about two weeks earlier than the Mountain variety. The yields in the three years (1913 to 1915) are as follows: Tartarian, 1, 1.3, and 8 bushels per acre; Mountain, 5, 3.5, and 16 bushels per acre, respectively. Buckwheat should apparently be grown in eastern Wyoming only in an experimental way.

SUMMARY.

The Cheyenne Experiment Farm is located on the plains of southeastern Wyoming at Archer, 8 miles east of Cheyenne. The elevation is almost exactly 6,000 feet. The station was established in July, 1912, and experimental work was begun in the fall of that year. The experiments reported herein, therefore, have continued three years.

The soil and climate are fairly typical of those of the district lying to the eastward. The results obtained are applicable to southeastern Wyoming and to adjacent small portions of Colorado, Nebraska, and South Dakota.

The soil is a light sandy loam, very productive when sufficient moisture is available. Heavier soils occur to some extent in other parts of the district.

The average annual precipitation at Cheyenne during the past 16 years has been 15.78 inches. The average seasonal precipitation (April to July, inclusive) during the same period has been 8.59 inches.

The evaporation from a free water surface during the growing season (April to July, inclusive) has been about 22.5 inches. The summers are rather short, without excessive heat. Hot winds do not occur. The average frost-free period is 125 days.

Experiments with wheat show that winter-wheat varieties have yielded higher than spring wheats in two years out of the three during which experiments have been conducted. The Ghirka Winter and Kharkof have been the highest yielding varieties.

Rate-of-seeding experiments with the Ghirka Winter and Turkey have given contradictory results during the three years. Four pecks

to the acre seems to be the best rate to sow. Early sowing, during the first half of September, has given the highest average yields.

Spring wheats have yielded less than winter wheats. Durum wheats have yielded more than spring common wheats. The Beloturka and Kubanka are the highest yielding durum varieties. Among the spring common wheats, varieties of the Preston group have outyielded Fife and Bluestem wheats.

Experiments on the rate of seeding durum wheat are not conclusive. So far, 2 pecks of the Arnautka variety have given the highest average yields. Sowing early, about the middle of April, has given the highest average yields for spring common wheat.

In experiments with oats the early varieties, Kherson and Sixty-Day, have given the highest average yields in two of the three years. In 1915, a cool, wet year, midseason varieties were better. The Swedish Select has given the highest average yield in the 3-year period.

Kherson oats sown at the 6-peck rate yielded better than when sown at lower rates. Early seeding, about the middle of April, has given the best results.

Experiments with spring barley show that the White Smyrna and Hannchen, both 2-rowed bearded hulled varieties, have given the highest average yields.

The Svanhals barley sown at the rate of 2 pecks and 3 pecks per acre has yielded more than when sown at higher rates. The same variety has given the best yields when sown rather early, from the middle to the latter part of April.

Compared with wheat, the yields of spring oats and barley have been rather low. Winter oats and winter barley have been failures.

Varietal experiments with flax show Montana Common and Select Russian to be the best varieties. Sowing at the rate of 15 pounds per acre has given the highest average yield, and sowing about the first of June has proved better than earlier seedings.

Neither winter nor spring emmer has proved of value. Foxtail and proso millets have given only low yields. Buckwheat does not appear promising.

Grain sorghums and corn are promising forage crops for roughage or silage, but apparently have little or no value as grain crops.

The following varieties of the principal grain crops apparently are best for this district:

Winter wheat.—Ghirka and Kharkof or Turkey.
Spring wheat.—Kubanka, Erivan, Marquis.
Spring oats.—Kherson, Sixty-Day, Swedish Select.
Spring barley.—White Smyrna, Hannchen.
Flax.—Montana Common, Select Russian.

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